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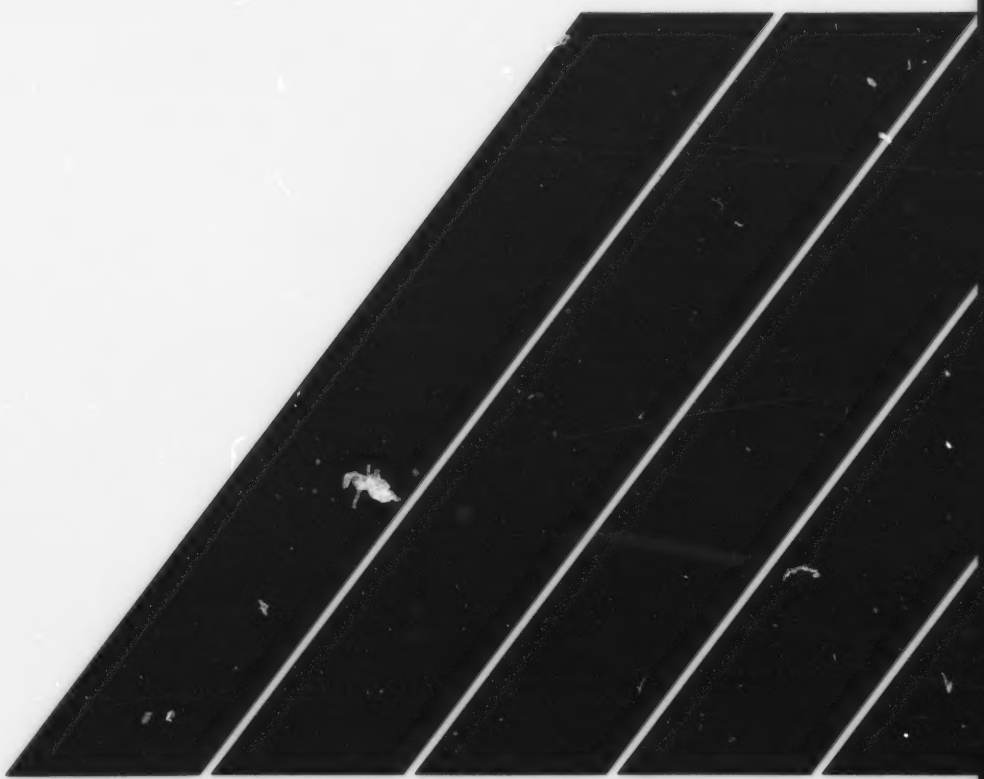

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Progress During the Second Half of 1991 in the Underground Uranium Mine and Surface Radiation Environment Projects of the Mining Research Laboratory (CANMET)

J. BIGU

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PROGRESS DURING THE SECOND HALF OF 1991 IN THE UNDERGROUND URANIUM MINE AND SURFACE RADIATION ENVIRONMENT PROJECTS OF THE MINING RESEARCH LABORATORIES (CANMET)

J. Bigu*

ABSTRACT

The summary of activities described in this report is designed to acquaint members of the Joint Panel on Occupational and Environmental Research for Uranium Production in Canada with the main project element objectives and outputs of the environmental projects (underground and surface) carried out by the Mining Research Laboratory (ELL, CANMET, EMR).

This report covers major outputs achieved by the technical staff of MRL from the last meeting of the Joint Panel, Saskatoon, Saskatchewan, June 12 to 13, 1991 to the present. Information on past outputs can be found in the following reports: MRP/MRL 79-46(OP), MRP/MRL 79-96(OP), MRP/MRL 80-78(OP), MRP/MRL 80-119(OP), MRP/MRL 81-72(OP), MRP/MRL 81-136(OP), MRP/MRL 82-56(OP), MRP/MRL 82-133(OP), MRP/MRL 83-50(OP), MRP/MRL 83-102(OP), MRP/MRL 84-59(OP), MRP/MRL 84-108(OP), MRP/MRL 85-90(OP), M&ET/MRL 86-1(OP), M&ET/MRL 86-72(OP), MRL 87-9(OP), MRL 87-83(OP), MRL 87-134(OP), MRL 88-65(OP), MRL 88-123(OP), MRL 89-73(OP), MRL 89-125(OP), MRL 90-061(OP), MRL 90-119(OP) and MRL 91-064(OP).

The descriptions that follow are pertinent to two areas of particular interest to members of the Joint Panel:

a) Radiation Source Identification, Measurement and Control;

b) Methods of Treating Tailings and Control of Effluents.

The project element number that appears on the right hand side of the headings refers to CANMET numbers. Other numbers, i.e., JP ..., refer to Joint Panel project numbers. Information regarding CANMET research projects is given at the end of this report.

Key words: Environment; Radioactivity.

*Research Scientist, Elliot Lake Laboratory, CANMET, Energy, Mines and Resources Canada, Elliot Lake, Ontario.

14.39.02 RADIATION (JP 500-507,512,513)

The main project element objectives are: to develop radiation instrumentation, and to undertake radiation studies to determine radiation levels produced in various mining operations; to identify the major factors affecting the release of radioactive products in mine air; to develop control methods capable of reducing radiation to acceptable levels; and to develop and operate test and calibration facilities for radon, thoron, and their daughters, and long-lived radioactive dust.

NATIONAL RADON/THORON TEST FACILITY (NRTTF) (Project No. 143902-11-2,JP 506)

A number of instruments will soon be calibrated as part of the Air Quality Assurance Program by the Radiological Protection Bureau (National Health and Welfare) in which a number of contractors which provide radon mitigation and home survey services will participate.

A continuous monitoring system of the actiave type (EDA-WLM-30) has recently been calibrated in ^{220}Rn, ^{220}Rn progeny only atmospheres. The calibration of the instrument will be used to analyze data taken in a $^{222}Rn/^{220}Rn$ survey in Manitoba by the Geological Survey of Canada (GSC) and the Atomic Energy of Canada Limited (AECL). The Elliot Lake Laboratory will participate actively in the analysis of these data.

Calibration work for uranium mine and mill companies is expected now that the Atomic Energy Control Board (AECB) has released its Consultative Document C-106 which provides guidelines for the type of calibration and calibration frequency of ^{222}Rn, ^{220}Rn progeny instrumentation used for personal exposure compliance purposes and other uses.

LONG-LIVED RADIOACTIVE DUST TEST FACILITY (LLRDTF)

The Long-Lived Radioactive Dust Test Facility (LLRDTF), in operation since early 1990, is particularly useful for airborne Long-Lived Radioactive Dust (LLRD) atmosphere simulation studies, as well as for intercomparison of

the performance of LLRD sampling instrumentation, for testing contamination of personal dosimeter sampling heads, and to investigate the electrical and particle size characteristics of LLRD under a variety of environmental conditions. An added and unique feature of this installation is that its special design enables injection of radon and thoron, in addition to LLRD. The LLRDTF has recently been used to carry out a comprehensive evaluation and study of the performance of LLRD instrumentation. This work was conducted for the AECB under contract to CANMET under the research contract entitled "Comparison of Radioactive Aerosol Sampling Instrumentation". The experimental study has been completed and some technical reports on the results have been submitted to the AECB for comments. The last report is due in December. A number of studies have been initiated (some of them already have been completed) on the effect of air water vapour content and some ionizing agents, such as radioactive sources and an ion-generator, on the electrical charge and particle size distribution of LLRD.

CHARACTERIZATION OF RADON (THORON) PROGENY AND LONG-LIVED RADIOACTIVE DUST

Studies of electrical charge and particle size distribution of Long-Lived Radioactive Dust (LLRD), radon progeny, and thoron progeny are being continued in the laboratory and in underground mines. Electrical charge and size distribution studies of uranium mine and tailings dust continue in the laboratory, particularly with dusts of high ^{226}Ra content. These studies are conducted in the new LLRDTF (see above).

The instrumentation used for the above studies was designed and built at the Elliot Lake Laboratory and consisted of parallel plate and split-flow elutriators and diffusion batteries. Cascade impactors and other ancillary instrumentation were also used in these studies.

EMANATION AND DIFFUSION OF RADON AND THORON

Two projects are presently in progress for extensive measurements of:

1) Emanation of radon and thoron from a variety of materials, and

2) Diffusion of radon and thoron through a number of materials.

For project 1) several experimental arrangements have been designed to allow emanation measurements to be conducted at normal atmospheric conditions (NTP, i.e., normal temperature, pressure), under vacuum conditions, and by degasing. In the latter case, materials are immersed in highly purified water or other suitable (liquid) fluid, and radon and thoron de-emanation is accomplished by bubbling an inert gas, such as Ar or He, through the liquid. Other alternative techniques are also possible using the experimental set-up indicated above. A report on ^{222}Rn emanation from several materials has recently been completed.

The experimental arrangement used in project 2) has already been described by the author in the literature. A report on the diffusion of ^{222}Rn through a variety of materials has recently been completed. The work was conducted at the RTTF.

The data obtained in these studies will be used in the Sudbury Neutrino Observatory (SNO) (see below), an international effort aimed at explaining and resolving unexpected results in the quantification of the solar neutrino flux component.

The above studies are part of a joint program between CANMET (Mining Research Laboratory) and the Department of Physics and Astronomy at Laurentian University, through the Sudbury Neutrino Observatory. A research technologist has been seconded (till the end of March 1992) to the Elliot Lake Laboratory (ELL) by Laurentian University and some funding by the latter to the ELL has also been allocated to conduct the work.

UNDERGROUND ENVIRONMENT CONTROL PROGRAM (JP 502)

At present, the following projects are in progress or have been completed:

1. Use of chemical and radioactive tracers to investigate radioactivity and

airflow conditions in underground uranium mines and mills (phases I and II complete, reports submitted to the AECB, but no response as yet from the latter).

2. Evaluation of a variety of radioactive aerosol sampling instrumentation under laboratory-controlled conditions and in an Elliot Lake underground uranium mine, and two Saskatchewan uranium mills. Experimental work has been completed and some technical reports have been submitted to the AECB for comments. The last report is due in December 1991.
3. Use of ventilation and recirculation as a means of controlling radiation levels in underground uranium and non-uranium mines (in progress, reports and papers published).
4. Removal of discrete radioactive sources to improve working radiation conditions in underground mines (in progress).
5. Electrical charge characterization of LLRD from various mining operations (in progress, two papers have been published, and several reports have been written)
6. Use of special polarized filter materials for the reduction of ^{222}Rn (and ^{220}Rn) progeny, and LLRD (in progress, two reports already written and two papers have been submitted for publication).

Great emphasis has been placed on radiation control methods and techniques and an extension of the above projects in a number of different types of uranium and non-uranium mines is being considered for the near future.

OTHER PROJECTS

In addition to the above, a number of other projects have been undertaken or are being continued by the Elliot Lake Laboratory:

1. Study on the diffusion and size distribution characteristics of thoron progeny using graded metal wire screens and parallel screens. This work is being conducted in collaboration with the U.S. Bureau of Mines (Denver Research Center, Denver, CO). The parallel screens work will be carried

out in collaboration with the USBM and the Lovelace Toxicology Laboratory (Albuquerque, NM). A technical report on some preliminary data obtained with graded wire screens is already available, and a more comprehensive study on the subject, completed in early 1990, has been summarized in a paper for formal publication. This work is being continued and is carried out in the RTTF.

2. Desorption of radon and thoron progeny from large surfaces by α- and β-recoil mechanisms, and other mechanisms, is underway. A paper on desorption of thoron progeny from large surfaces has been published (August 1991) in Health Physics Journal. A technical report on the same subject but for radon progeny was published (MRL Report) in 1990.
3. Studies on:
   a) Emanation of radon and thoron from materials, and
   b) Diffusion of radon and thoron through materials.

These studies (already mentioned, and conducted in collaboration with the Department of Physics and Astronomy of Laurentian University and Queen's University) are part of the Sudbury Neutrino Observatory (SNO) radioactivity measurements program aimed at selecting the most suitable component materials in the construction of some crucial (material) structures to be used in the SNO. This is absolutely necessary in order to minimize interference of unwanted radionuclides with the detection and measurement of solar neutrinos, the primary objective of SNO.

143911 TAILINGS MANAGEMENT TO MINIMIZE ENVIRONMENTAL IMPACT

The project element objective is to develop methods of tailings disposal and surface stabilization of inactive tailings piles to reduce the detrimental effect of contaminated transport via wind and water erosion, surface runoff, and groundwater infiltration as a subsurface seepage. (Note: The group responsible for this work is now part of the Minerals Science Laboratory (MSL)).

DEVELOPMENT OF WET BARRIERS ON PYRITIC URANIUM TAILINGS (Rio Algom) (Project No. 143911-01-03, JP 508)

The project objective is to establish a saturated hydrologic condition at the surface of pyritic uranium tailings and develop an appropriate wetland vegetative cover to:

a) act as an oxygen barrier and hence control acid generation;

b) stabilize the surface; and

c) minimize surface water contamination.

Laboratory lysimeter and small scale field 'plot' tests are being carried out on various tailings sites to monitor the effects of the individual or combined effects of treating the tailings by: flooding, leaving them unflooded; treating them with applications of limestone or some other surface ameliorating chemical/substance revegetation; and leaving them fallow to revegetate naturally.

Procedures and methodologies are being developed to carry out a large scale demonstration on a 40 ha section of the Quirke Mine tailings (western end).

Impact of shallow water cover with wetlands is also being investigated. Over a 5-year period, both field and laboratory investigations are being undertaken in order to evaluate the hydrogeochemistry of pyritic uranium tailings with various types of wet barriers.

CONTAMINANTS MIGRATION FROM SULPHIDE AND URANIUM TAILINGS (Rio Algom, Denison, AECB, Laurentian University) (Project No. 143911-15-03, JP 511)

Techniques are being developed to assess migration of contaminants from uranium tailings via air and water pathways. Migration of contaminants from tailings to vegetation, to herbivores and insects, and various other food chains have also been studied to evaluate their ultimate impact on man. At present, work is being carried out on fish in the Serpent River watershed to determine the impact of uranium waste management.

ACKNOWLEDGEMENT

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JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM IN CANADA

DATE: December 1991	REPORT ON PROJECT PROGRESS	PROJECT #

TITLE	MATRIX LOCATION
EMANATION AND DIFFUSION OF RADON AND THORON	

PROGRESS/STATUS

THE PROJECT IS AIMED AT MEASUREMENTS OF:

1. Emanations of radon and thoron from a variety of materials and
2. Diffusion of radon and thoron through a number of materials

For project 1) a special experimental arrangement (set-up) has been designed and built that will enable these studies to be conducted. Further extension and modification of this set-up will most probably be necessary in the future. The experimental set-up needed for project 2) is already operative.

Projects 1) and 2) are part of the Sudbury Neutrino Observatory (SN0) programme of measurements and are conducted in collaboration with the Departments of Physics and Astronomy of Laurentian University and Queen's University.

CHANGES	ANTICIPATED COST
Two reports submitted on Items 1 and 2. Work in progress.	ANTICIPATED COMPLETION DATE: March 1993

SPONSORS	CONTACT
CANMET, Laurentian University, SNO	J. Bigu, CANMET

JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM IN CANADA

DATE: December 1991	REPORT ON PROJECT PROGRESS	PROJECT # 513

TITLE INTERCOMPARISON OF RADIOACTIVE AEROSOL SAMPLING INSTRUMENTS	MATRIX LOCATION

PROGRESS/STATUS

This project was initiated in Nov. 1989. A literature search has been completed (and a report submitted) with regards to instrumentation in common use and sampling and calibration techniques. The Long-Lived Radioactive Dust Test Facility (LLRDT) designed for this project is in full operation and a considerable amount of data have already been collected on the performance of several instruments in common use. Several types of dusts have been used in these tests.

CHANGES	ANTICIPATED COST
Experimental work has bee completed and some technical reports have been submitted to the AECB for comments. The last report is in the typing process.	90K
	ANTICIPATED COMPLETION DATE December 1991

	CONTACT
Atomic Energy Control Board	J. Bigu, CANMET

JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM IN CANADA

DATE: December 1991	REPORT ON PROJECT PROGRESS	PROJECT # 513

TITLE INTERCOMPARISON OF RADIOACTIVE AEROSOL SAMPLING INSTRUMENTS	MATRIX LOCATION

PROGRESS/STATUS

This project was initiated in Nov. 1989. A literature search has been completed (and a report submitted) with regards to instrumentation in common use and sampling and calibration techniques. The Long-Lived Radioactive Dust Test Facility (LLRDT) designed for this project is in full operation and a considerable amount of data have already been collected on the performance of several instruments in common use. Several types of dusts have been used in these tests.

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	CONTACT
Atomic Energy Control Board	J. Bigu, CANMET